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Towards a network-based view of effective entrepreneurial ecosystems

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Abstract

We conceptualize entrepreneurial ecosystems as fundamentally reliant on networks and explore how and under what conditions inter-organizational networks lead an entrepreneurial ecosystem to form and evolve. It is widely accepted that entrepreneurial ecosystems possess a variety of symbiotic relationships. Research has focused considerable efforts in refining the structure and content of resources found within these networked relationships. However, merely focusing on actor-level characterizations dilutes the notion that social relationships change and are complex. There has been little conceptual treatment of the behavioral and governance factors that underpin how quality interactions composing an entrepreneurial ecosystem develop and change over time. In response, we provide a longitudinal ethnographic study examining how ecosystems are managed and evolve in their relational configurations and governance at critical junctures. Using mixed methods and data collected over 3 years, we reveal a cyclical process of relational development central to the initiation, development, and maintenance phases of a valuable entrepreneurial ecosystem. We contribute to a conceptualization of effective ecosystems as reliant on networks, we reveal the behavior and governance characteristics at play in the entrepreneurial ecosystem during each phase of its evolution.

Keywords Entrepreneurial ecosystems · Relational governance · Longitudinal · Network theory · Networks · Effective ecosystems · Ecosystem evolution

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1 Introduction

Entrepreneurship plays a pivotal role in economic growth (Davidson et al. 2006; Mason and Brown 2013). High-growth entrepreneurial ventures are prized for their ability to innovate new products and services, improve wealth, enhance living standards, and contribute to communities in general (Uyarra and Ramlogan 2016). As such, political bodies and governments worldwide view entrepreneurship as a cornerstone to any national economic growth and resilience agenda (see for example the OECD, UK Industrial Strategy 2017, USA Comprehensive Economic Development Strategy, among many others). The imperative is clear: identifying, supporting, and investing in cultivating entrepreneurial outputs is essential for economic growth, and entrepreneurial ecosystems are viewed as a potential solution to fostering the economic imperative of entrepreneurship (Stam and Spigel 2018). This has led to a tendency among policymakers to import practices seen among thriving ecosystems (i.e., various funding mechanisms/incentives, platforms, policy) on the assumption that such practices are somehow ‘best’ while omitting interdependencies (Harrison and Leitch 2010; Motoyama and Watkins 2014; Spigel 2017). However, while there has been progress in creating and understanding the various mechanisms and frameworks needed for entrepreneurial environments to foster high-growth ventures, there is considerable evidence that some regional ecosystems are more conducive to the production of successful ventures than others (Li et al. 2015; Spigel 2017). The inconsistency in the effectiveness of entrepreneurial ecosystems suggests that merely a focus on structural attributes is but one piece of the puzzle. For instance, scholars have long recognized that entrepreneurship does not thrive in isolation (Mezias and Kuperman 2001). We view entrepreneurial ecosystem performance as fundamentally reliant on a relations and features of their governance. However, research on behaviors, inter-dependencies and relational governance in entrepreneurial ecosystems remains substantially underdeveloped and represents a crucial barrier to understanding when and why ecosystems flourish or flounder. (Aarikka-Stenroos and Ritala 2017; Kang et al. 2019; Scott et al. 2019; Spigel 2017). We attempt to address this critical oversight and contribute to a network-based view of entrepreneurial ecosystems (Spigel 2017).

Traditional studies acknowledge that entrepreneurial outcomes rely on interactions within broader social, cultural, and environmental contexts (Feldman and Florida 1994; Isaksen 2016, 2018; Ferreira et al. 2019). For example, a stream of entrepreneurial ecosystem research has developed an understanding of the social contextual factors that influence entrepreneurial outputs (Beliaeva et al. 2019). Within this stream, authors focus their efforts on the factors that influence access to and use of interactions within complex and broader social environments. While promising results have emerged, this body of work is still in its infancy (Mueller and Jungwirth 2016; Kang et al. 2019). Central to this research is the emerging pattern among descriptive accounts of the dependency the entrepreneurial

ecosystems have on local conditions (Cavalo et al. 2018). These studies draw attention to the complex nature of network composition (Oerlemans et al. 2001). Network composition (i.e., its structure and content) is a priority to understanding when an ecosystem thrives or flounders. However, the focus on the components of these environments has led to an oversimplification of how the relationships held between entities create or prevent entrepreneurship. These studies generally depict relationships as merely a link to knowledge access or financial resources. Instead, ecosystem theory should focus on how these relations are governed to produce and reproduce vibrant, wealth-creating new ventures. A relational and network view of entrepreneurial ecosystems helps differentiate between the content and structure of the network as reproducible elements to more in-depth examinations of how governance behaviors truly create and support an ecosystem. Nevertheless, there remains a significant lack of studies that probe the networking activities and relational elements explaining how and under what conditions inter-organizational networks lead an entrepreneurial ecosystem to form and evolve.

This study responds to this gap by answering two related research questions necessary for a relational and network view of entrepreneurial ecosystems: (1) *How does an entrepreneurial ecosystem evolve and mature productively across phases over time?* (2) *What relational governance mechanisms influence ecosystem adaptation at each phase?* Data from a three-year, longitudinal, mixed-method research study of an established and influential university-business partnership forming a valuable entrepreneurial ecosystem in its region is used to explore the processes and governance features generating a vibrant and wealth-creating entrepreneurial ecosystem. Breaking from tradition, we conceptualize entrepreneurial ecosystems as fundamentally reliant on networks. We provide a conceptual and empirical treatment of the behavioral and governance factors that underpin how quality interactions composing an entrepreneurial ecosystem develop and change over time. We further provide a longitudinal ethnographic study examining how this ecosystem is managed and how it evolves in its relational configurations and governance at critical junctures. We contribute much-needed new information on the factors that influence the development of relationship governance structures and the evolution of an entrepreneurial ecosystem across distinct phases. In doing so, we contribute to a conceptualization of effective ecosystems as reliant on networks and shed new light on ecosystem relationships. Collectively, these insights contribute to advancing a network-based view of entrepreneurial ecosystems as called for by Spigel (2017).

2 Theoretical background and literature

2.1 A relational perspective on entrepreneurial ecosystems

The ecosystem concept has gained traction across a broad range of entrepreneurship- and innovation-focused disciplines in recent years (Russell and Smorodinskaya 2018; Spigel 2017). Borrowing principles from biological studies, the ecosystem concept can be broadly characterized as complex interactive systems

(Autio and Thomas 2013) that sustain ‘life’ through evolving conditions, cycles, and energy flows (Scarigella and Radziwon 2017). In the lexicon of entrepreneurship, authors essentially agree that the durability and performance of any given ecosystem are influenced by varying resources (Garnsey and Leong 2010), environmental conditions (Breitenecker et al. 2016; Sun et al. 2019), and entities (Pilinkienė and Mačiulis 2014). However, while the structure and content of various ecosystems are similar across studies, evidence suggests that engagement within these complex systems vary due to actor-level perceptions (Scott et al. 2019), roles (Valkokari 2015), and decision-making behaviors (Kapoor and Lee 2013). Stated differently, the vibrancy and the wealth-creating potential of an ecosystem relies on interaction first and foremost.

High-growth ventures, especially the high-technology variety, burn through resources at a relatively fast rate (Hughes et al. 2020). These firms may not have the internal capacity to generate the knowledge required for timely new ventures (Perez-Luno et al. 2011), respond to market changes (Rothwell 1994), or the capabilities needed to compete within risky initiatives (Powell 1990). These firms have long recognized the benefits of interacting with actors in their environment to access resources and acquire or attract entrepreneurial activities (Scott et al. 2019; Yin et al. 2020). Nevertheless, they hold an innate potential to access unique resources, expertise, or technologies from various external organizations (Hughes et al. 2007; Inkpen and Tsang 2005; Kogut and Zander 1992; Reagans and McEvily 2003; Scott et al. 2019). Stated differently, their ability to generate successful new ventures lies in their ability to effectively navigate, enact, and exploit opportunities made available within networks.

Thinking of entrepreneurial ecosystems as networks depict pathways to accessing resources and finance (Powell 2002), for knowledge spill-overs with other like-minded firms or supporting institutions (Owen-Smith and Powell 2004), and the easing of institutional barriers (Feldman and Francis 2004). However, a network view of entrepreneurial ecosystems carries two vital implications that resolve deficiencies in structure- and content-based views of ecosystems: that ecosystems simply present the opportunities for such benefit but not necessarily their access (Hughes et al. 2007; Scott et al. 2019). A network (or relational) perspective on entrepreneurial ecosystems places interdependencies and interactions among actors as core to explaining why one ecosystem outperforms another. This perspective can also shed light on why the idea of drawing ‘best’ practice from one ecosystem to another is flawed without those interdependencies and can help predict what governance mechanisms are needed to steer interaction across time. As Spigel (2017, p.50) notes, “entrepreneurial ecosystems need to be more than a label for regions with high rates of entrepreneurship. Rather, ecosystem theory should focus on the internal attributes of ecosystems and how different configurations of these attributes reproduce the overall ecosystem and provide resources to new ventures that they could not otherwise access.” Entrepreneurial actors resident in entrepreneurial ecosystems must transcend their organizational borders (Chesbrough 2003, 2007; Chesbrough et al. 2006; Huizingh 2011; Sisodiya et al. 2013). However, scholars are yet to unveil deeply how entrepreneurial actors might enact and maintain relationships within entrepreneurial ecosystems and

ever-changing environments (Autio and Thomas 2013). An interaction element is essential.

Entrepreneurial actors engage with various ecosystems to address resource and knowledge needs (Kapoor and Lee 2013; Xu et al. 2018; Russell and Smorodinskaya 2018). However, entrepreneurial ecosystems are different from both an innovation ecosystem (one typically oriented toward co-innovation) and a knowledge ecosystem (one typically oriented toward knowledge access, diffusion, and transfer) (e.g., Aarikka-Stenroos and Ritala 2017; Kapoor and Lee 2013; Pilinkienė and Mačiulis 2014; Mazzucato and Robinson 2018; Scaringella and Radziwon 2017; Velkokiari 2015; Xu et al. 2018). Entrepreneurial ecosystems represent interdependent actors and factors coordinated to enable productive entrepreneurship within a particular region or territory (Stam and Spigel 2018). Effective entrepreneurial behavior then must transcend beyond network structures (Aarikka-Stenroos and Ritala 2017; Hughes et al. 2014; Rapp and Olbrich 2020; Scott et al. 2019; Spigel 2017). The coordination of complex social and human behavior is required to generate knowledge necessary for different outputs (Kogut and Zander 1992; Nonaka 1994; Rodan and Galunic 2004). Networks can be considered the glue that enables and unlocks the power of entrepreneurial ecosystem, and its essential elements require further examination. A coordination (or orchestration) element is essential.

2.2 Networks in entrepreneurial ecosystems

Many potential partners can be embedded in entrepreneurial ecosystems, including nascent entrepreneurs, SMEs, venture capitalists, lead users, end consumers, universities and scientists, mentors and dealmakers, and the like (Keupp and Gassman 2009; Spigel 2017; Scott et al. 2019). The benefit of engaging within a network lies within the flexible ability for an actor to remain as a semi-autonomous node in their area of specialism (Bluedorn et al. 1994) while also accessing resources that would either be unavailable, inaccessible, or difficult to access (Daata 2011; Powell 1990). When entrepreneurial actors can access or transmit ideas and other forms of knowledge within networks of relationships, spillovers can occur. More ideas and knowledge are shared or accessed among the actors comprising the network (or ecosystem) (Daata 2011; Schroder 2020). This flow of knowledge and resources holds the potential for actors to learn faster (Dyer and Hatch 2004) and innovate better (Chang et al. 2006; Mooi and Frambach 2012). Through creating borderless organizations and building inter-organizational cooperation (Kim et al. 2010), networks can help circulate resources and knowledge (both explicit and tacit), enhance innovation and learning, and facilitate entrepreneurship (Aldrich and Zimmer 1986; Hoang and Antoncic 2003; Koka and Prescott 2002; Spigel 2017; Zardini et al. 2020).

The importance of social networks to entrepreneurship is well-documented (e.g., Hoang and Antoncic 2003; Nijkamp 2003; Stuart and Sorenson 2007). However, accessing and releasing the resources, knowledge, new relationships, finance, opportunities (among the many other purported benefits of networks and ecosystems) is contingent upon the careful coordination of complex human and social elements, and behavior (Hughes et al. 2007, 2014; Kogut and Zander 1992; Rodan and Galunic

2004). An entrepreneurial ecosystem succeeds when its entrepreneurial dimension (the process by which for creating new goods and services are explored, evaluated, and exploited) is elevated by its interaction dimension (that entrepreneurship takes place in a community of interdependent actors) (Stam and Spigel 2018) are satisfied. Ecosystem relationships require careful orchestration or else be left to happenstance or chance.

Network theory focuses on the interdependent nature of actors (nodes) and the relational linkages (ties) to determine the flow of resources (e.g., social capital and knowledge) within a network of relationships (Wasserman and Faust 1994). Salient networks in an entrepreneurial ecosystem are both inter-organizational and inter-personal (e.g., Sedita 2008). The act of resource diffusion occurs through the relational links to the node (Robertson et al. 2012; Pentland 2014). This is essentially a behavioral problem and, as such, network governance is important as it defines the various social mechanisms at play that impinge on behavior (Jones et al. 1997). Such behaviour is also vulnerable to the context of the relationship and partner selection (Shah and Swaminath 2008) and difficulties in aligning cultures between actors (Herzog and Leker 2010). The process of unlocking access to knowledge and resources and enabling their transfer in value-creating ways depends on actors' network behavior. It so represents a behavioral feature of networks (Ng and Feldman 2010). In any entrepreneurial ecosystem then, opportunities for entrepreneurship and entrepreneurial innovation must be enacted by individuals/actors whose behavior elicits trust, reciprocity, and the will to make available and transfer the knowledge and resources necessary for value creation (Hughes et al. 2014; Scott et al. 2019; Spigel 2017). Contrary to policymakers' practice to cherry-pick over 'best' practices from seemingly successful entrepreneurial ecosystems in different territories or regions, how an actor accesses resources (etc.) may be relationally specific and determined by local (network) conditions in the entrepreneurial ecosystem.

2.3 Relational governance and network orchestration

Relationships represent multi-faceted forms of cooperation and are dependent on mutual benefit, trust, interaction, and open communication channels aimed at sharing risk and resources in a way that extends beyond contracts (Powell 1990; Zaheer et al. 1998). Relational governance is strongly associated with providing an environment conducive to resources and knowledge exchange (Carmeli and Azeroual 2009). In general, governance is understood to be how an organized social and collective entity is created, directed, and reinforced to develop normative behaviors. Ultimately, the realization of value depends on the extent to which the relationship(s) between actors impacts their implicit 'value' for transacting the resources available within the network (Adler and Kwon 2002; Hughes and Perrons 2011; Inkpen and Tsang 2005; Nahapiet and Ghoshal 1998). A further body of literature associates these relational capabilities with productive entrepreneurial and innovative outcomes (e.g., Kale et al. 2000; Mooi and Frambach 2012; Sisodiya et al. 2013; Spigel 2017). Cooperation and trust build over time (Huemer 2014), and recent studies

have called for a focus on relational (Scott et al. 2019; Hughes et al. 2014) and developmental (Ng and Feldman 2010) behaviors to explain why one set of relationships, or network, becomes more productive than another even when replicating the properties of its structure or content.

Extended to an entrepreneurial ecosystem, then, the social aspect of the network(s) within the ecosystem matter is whether it can productively contribute to the actors' agency within it (Scott et al. 2019). Treating an entrepreneurial ecosystem in isolation from network theory suggests that an ecosystem's mere structure and content inherently creates wealth devoid of an agency from the actors themselves. We challenge this assumption and argue that the relational organization of the entrepreneurial ecosystem matters (Spigel 2017). First, while an actor's network position can determine their influence on the network (Schepis et al. 2014), the whole of the network matters for governance and learning (Makadok 2003) because degrees of knowledge heterogeneity influence performance (Hughes et al. 2014; Rodan and Galunic 2004) and the outcomes that may be drawn from the network (McEvily and Zaheer 1999). The relational component of trust takes time to develop and depends on how actors behave with one another. Trust provides the ability to unlock access to (or share) resources and knowledge with others regardless of the ecosystem's structure or content (e.g., Bouncken et al. 2020; Scott et al. 2019). Second, the levels of uncertainty avoidance and protection of proprietary information in inter-firm collaboration have the potential to inhibit behavior, further emphasizing the importance of relational governance (Kale et al. 2000; Barr and Glynn 2004; Zaheer and Venkatraman 1995) in ways that encourages knowledge sharing and to facilitate entrepreneurial and innovation outcomes. Most studies employing social capital theory acknowledge trust and reciprocity within interactions to be crucial relational components in the generation of social capital. By working together, actions are driven by common (instead of competitive) interests that can serve to improve conditions across several stakeholders involved in the relationship (Scott et al. 2019). Concurrently, trust in business relationships as extends from individuals' behaviors within and among organizations rather than from the organizations themselves (Zaheer et al. 1998). Differentiating between individual and organizational levels holds implications for the transmission of ideas and knowledge flows (Ganseen and Hess 1997).

Given Zaheer et al.'s (1998) observation about trust and the execution of relationships taking place at the individual as opposed to a firm level, trust and norms are potentially a more effective governance mechanism than contracts in the successful and effective management of relationships. Network behavior leads an actor to maintain unique and idiosyncratic patterns of network linkages and the significant differential exposure to knowledge and ideas. Despite an implicit acceptance among existing studies that the social capital needed to unlock learning is behaviorally driven, there is a general absence of understanding into that behavior, its governance, and its orchestration (Granovetter 1973; Hughes et al. 2014; Ng and Feldman 2010; Stuart and Sorenson 2007).

In essence, sufficient trust motivates parties to share scarce resources (Kwon et al. 2013), which helps form dense networks necessary for productive entrepreneurship (Aldrich and Zimmer 1986), and dense links are forged regionally by

frequent interactions (Schutjens and Völker 2010). Orchestrators (such as mentors, dealmakers, and other actors) can encourage these interactions. However, we posit their sustenance and growth depend on governance mechanisms regulating productive behavior among actors in the networks inside the entrepreneurial ecosystem. A relational governance perspective is therefore essential to improve understanding of productive entrepreneurial ecosystems.

Our research objective is to delve into the relational and network perspective of entrepreneurial ecosystems, building on calls by Aarikka-Stenroos and Ritala (2017), Scott et al. (2019) and Spigel (2017), necessary because the behavior of actors within the ecosystem and networks that form among them are central to the movement and transmission of resources and knowledge. In effect, without scholarly knowledge of network and relational governance in entrepreneurial ecosystems, we are left with the flaw currently exhibited by policymakers: the tendency to mimic apparent ‘best’ practices in ecosystems in other regions or territories on the assumption that structure and content create value. They do not. Instead, they merely offer opportunities to do so, but whether these are realized or not depends on actors’ behavior within an ecosystem and the governance of those relations (e.g. Scott et al. 2019; Hughes et al. 2007, 2014).

3 Research design and methodology

To generate data to understand entrepreneurial ecosystems as networks and relational governance, we use an ethnographic study following a longitudinal research design (Hanneman and Riddle 2005; Carrington and Scott 2011). We supplemented this design with other mixed-method data collection to enable multilevel triangulation and continued data collection until the point of theoretical saturation (Yin 1994). We used a continual comparison method to identify and collect evidence of the components for managing interactions between entities, sub-units, and corresponding actors (Gephart 2004). This allowed the researchers to identify theoretical similarities to engage with subsequent analytical categorization more accurately.

The study ran from October 2013 to January 2017, representing a longitudinal study (Eisenhardt 1989; Yin 2013) to understand how relationships within the ecosystem evolved and how changes occurred within and among those relationships (Van de Ven 2007). This method afforded a rich treatment of the phenomenon (Sigelkow 2007). We selected the case for theoretical sampling purposes. The case represents a highly regarded, award-winning university-business partnership that has become the foremost and influential element of stimulating entrepreneurial ecosystem activity within its region in England. The business organization studied operates on a global scale in the fast-moving consumer goods industry. The university organization is a strong institution of international repute. The inter-organizational relationship, and the ecosystem that ultimately formed, initiated through a period of pilot studies in 2011. Between 2011 and 2012, many aspects of the relationship’s micro-level functioning emerged organically and in response to various internal and external stimuli. Recognizing the value and potential future performance future collaboration could provide, the relationship developed a governance board to sustain

its vitality. It is at this stage that data collection began. How this business-university partnership interacts within the regional ecosystem has since been highly lauded by members of the ecosystem and broader external entities and world governments. At the time of data collection, the relationship had generated over £20 M and leveraged over £10 M in governmental and research council support. It is considered an exemplar case study for industrial engagement and has been lauded amongst policymakers' highest tiers across the globe. From 2011 through 2016, the relationship led to 66 funded entrepreneurship and innovation projects with 162 individuals embedded in the focal ecosystem. These projects were scaled across various knowledge transfer and acquisition targets and included individuals collaborating on projects in chemistry, physics, biology, psychology, business, mathematical sciences, and history. Many funded projects were conducted in collaboration with external local SMEs, entrepreneurs, and research institutes, collectively growing the ecosystem. The relationship also involved technology transfer, finance, and legal professionals. While the relationship initially formed due to geographic proximity and the potential to access shared resources, its development eventually led to the inclusion of actors from the United Kingdom, United States, Germany, Italy, and Singapore. It became one of the foremost entrepreneurial ecosystems within the region.

Over the 3-year duration of the project, data were arranged into a chronology of core events and exhibited behaviors to provide an overview of evolutionary processes. While we acknowledge the duality and inseparability of network structure and agents, this study is primarily focused on conceptualizing the factors that drive governance between entities in the ecosystem as described above. Given the level of influence that this particular relationship represented and that the conceptualization of a relational perspective on entrepreneurial ecosystems is thin (Spigel 2017), this study adopted an exploratory stance. We sought to identify individual behaviors within the network to further our understanding of various outcomes and phases in developing the entrepreneurial ecosystem (Wasserman and Faust 1994; Cross and Parker 2004; Kadushin 2012; Carrington and Scott 2011). The intention was to identify behaviors and features of relational governance associated with outcomes within networks throughout the entrepreneurial ecosystem to make recommendations for future examination (Glaser and Strauss 1967; Eisenhardt 1989). The means to which governance coordination occurs is multi-faceted as well, with several different means to which social norms are communicated. The means to which multi-method data collection occurred are described within the next section.

3.1 Data collection

The in-depth access provided by the stakeholders to this study awarded rare insights into the relational exchanges, behaviors, and functioning of the ecosystem. The first phase of data collection used snowballing techniques to uncover critical network members (Prell 2011). Participant observations occurred throughout the setting (Schwartz and Schwartz 1955; Gold 1958; Bryman 2001; Yin 2013) from monthly and quarterly executive board meetings, interviews, and a series of informal interactions. Additional data were collected from direct observations of monthly technical

meetings, allowing a more passive means of observing the relationship. The goal was to observe but not interfere with interaction patterns (Silverman 2015; Yin 2013). Furthermore, access to all relational management and coordination documentation from the study's onset allowed for a further longitudinal lens. Secondary data were collected from internal documents, presentation materials from workshops and conferences, and information displayed in the public domain, such as press releases, books, articles, and website information. This procedure enabled triangulation (Glass 1976) and served as augmenting evidence to identify corroboratory versus contradictory evidence (Wasserman and Faust 1994). The secondary data access provided the opportunity to explore the level of network involvement and communications between members in an objective way.

3.1.1 Participant observations

Approximately 76 h of participant observations were recorded. This data collection method ran between 2013 and 2016 and included 15 semi-structured interviews, 14 executive board meetings, 9 respondent validation meetings, and 4 research dissemination meetings. This method was designed to capture an understanding of participants' roles and histories within the relationship. Therefore, this form of data collection focused on the senior members of the focal relationship, including directors, technical managers, and functional managers from both sides of the relationship. Eight participants from the business organization were sampled. The sample included two global directors, a finance manager, two scientific partnership leads based in the UK, one global director, one regional director, and one scientific partnership lead. The sample included four head of subject departments, a director of research, and two technology transfer directors on the university side.

The semi-structured interviews and informal follow-up meetings were constructed to have open-ended questions and focused on the network's inner working and identifying key events that led to its formation and evolution. This allowed the participants to communicate their perspectives with minimal interference from the researchers (Silverman 2015). Key informants remained in contact for further data validation throughout all research phases (Gephart 2004; Miles and Huberman 1994). A further nine informal interactions were recorded due to the highly valuable continued insights the participants provided throughout the project and respondent validation. This primary data collection approach allowed the researchers to engage in the relationship appropriately (Yin 1994). Approximately 23 h of participant observation techniques were recorded over the three-year duration of the projects. All recorded interviews were later transcribed as part of the data reduction process and coding procedure. Field notes were transferred to digital logs.

Furthermore, participant observations occurred through the attendance to fourteen monthly and quarterly executive and partnership governance meetings. These regular meetings included the attendance of most UK-based informants previously described and continued throughout the project. The primary focus of these meetings was on strategic planning and resource allocation for future initiatives and addressing potential institutional pressures by reviewing and responding to external communications. This data collection technique allowed the researcher

to derive deeper meaning from the observations as it allowed the opportunity to ask questions and allow for moderate participation in the research setting (Silverman 2015; Miles and Huberman 1994). These meetings were not recorded, but field notes were permitted. There were approximately 42 h of data collection recorded in this data collection method. Additionally, annual respondent validation events and research dissemination were delivered four times and included another 11 h of data validation and insights.

3.1.2 Direct observations

Approximately 50 h of direct observations were recorded as well. Direct observations were collected through the attendance to technology transfer workshops and included a broader scope of actors than those observed within the participant observations. The projects and content discussed at these meetings revealed technical contributions and insights from several local, regional, and international firms. Key members of the governing Board, observed in the participant observations, were regularly present, including the two scientific leads from the business organization and three head of subject department leads. This further included a broad scope of participants across various roles, including 27 academic principal investigators, 6 organizational, technical scientists, and 18 Ph.D. candidates. The direct observations allowed the researcher to retain a passive role while observing interaction patterns and activities in a natural setting (Miles and Huberman 1994). This allowed the researcher to observe the interaction patterns among the actors within the setting without interfering in the event's overall design (Silverman 2015). This form of observation benefits from fewer risks of socially desirable responses by the participants (Myer and Goes 1988) and allows the story to unfold without the researcher imposing influence on the activities being conducted. This allowed the researcher to remain detached from the participants being studied and allowed for a more objective view of how governance was communicated throughout the broader social structure.

3.1.3 Secondary data

A total of 223 internal documents, presentation materials from workshops and conferences, and information displayed in the public domain, such as press releases, books, articles, and website information, were collected. These documents were intended for the management and coordination of the relationship and provided a lens into the coordination and organization of the relationship. The re-analysis of existing information characterizes secondary data for answering the questions at hand (Glass 1976). The benefit of retrieving the archival documents was that they augment evidence for other sources to reflect the corroboratory versus contradictory evidence (Wasserman and Faust 1994). The collection

of archival documents allowed the researcher to retrieve objective data regarding members of the network and the relations that exist per contractual coordination.

3.2 Analysis methods

We compiled all the data into a unified database, tabularized it, and labeled it according to emerging first-order themes, date, and source (Miles and Huberman 1994; Gioia et al. 2013). The data was evaluated through thematic analysis techniques and induction (Miles and Huberman 1994; Yin 1994; Creswell 2009).

We then formed a chronology of events in the evolution of the entrepreneurial ecosystem and its networks. This chronology aided in analyzing the episodes of network evolution that occurred since the origin of the relationship. Taking a longitudinal lens then, all data were compiled and drafted into a historical development and timeline (Silverman 1993). A common theme to understanding the inner working of this overarching university-business relationship and the emerging entrepreneurial ecosystem was that its scale grew organically and in a more fragmented way, as emphasized by senior participants. This chronology revealed several critical events over time and led us to identify four significant tipping points triangulated by archival documents and participants' accounts. These were crucial points when the entrepreneurial ecosystem and its internal networks responded to internal and external pressures. This analysis identified patterns that reflected a level of stability, development, and adaptation/coordination through significant events across the timeline. This historical recount of the relational development was contrasted with Cross and Parker's (2004) notion of network evolution. This approach reveals the co-evolution in which the ecosystem was built and the endogenous processes contributing to its effectiveness (Wasserman and Robins 2005).

Thematic analysis (Miles and Huberman 1994) is used to examine the qualitative data generated from the study's exploratory phase. This enabled new patterns to be discovered (Yin 1994) and identify and make sense of the relational activities and mechanisms between different stakeholder groups (Faria and Wensley 2002). This also enabled a more careful exploration of the interaction between the evidence and existing theory to emerge (Strauss and Corbin 1990; Hughes and Perrons 2011). Throughout the data collection and the iterative process of identifying themes continued until theoretical saturation and further analysis no longer yielded fresh insights (Yin 1994). The early phases focused on the "continual comparison between the actors and their subunits based on the theoretical similarities and differences" (Gephart 2004: 459). The research utilized multiple points for qualitative data collection, such as semi-structured interviews, participant observations of monthly technical meetings, field notes collected at regular board meetings, relationship-themed presentations, and informal networking events. This allowed for the convergence of the variables of interest and relied on converging multiple sources of evidence. The benefits of using this approach in the early stages are the development of theoretical propositions that further guide the data collection exercises (Yin 1994). This allowed for new theoretical concepts to emerge from the field and allowed the researcher to modify and broaden

the initial categories through iterative and constant comparison (Silverman 2015). It is the belief that is adopted by many qualitative researchers who seek to illustrate the contextual details of an investigation during the inductive phase, and that would otherwise be overlooked utilizing objective (e.g. quantitative) methods alone. These themes allowed the researcher to identify the prevalence of the compositional characteristics, the network's size, idiosyncratic pockets, and sub-groups within the network. This analysis also aided in identifying the different relational contexts in which actors interacted with each other, and therefore provided the basis for understanding the complexity of the relational linkages that characterize this network. The coding process is illustrated at the relevant point in the next section.

4 Analysis and results

4.1 Evolution of the networks within the ecosystem

The first set of evidence confirms that networks are not static (Hughes and Perrons 2011; Nonaka 1994), driven by the oscillation of new members by members leaving or joining, and internal and external (stakeholder) pressures. These change the composition of network structure and content and influence the resources and knowledge available and their sharing. Thus, the entrepreneurial ecosystem evolves through different stages of flux and stability. Prior research suggests that the ability to connect and share valuable insights depends on several social-psychological factors (Scott et al. 2019), organizational climates, and various external factors that often change (Bluedorn et al. 1994). Because of this, studies have sought to identify network type and the complexity of the content diffused through its structure (Rodan and Galunic 2004; Inkpen and Tsang 2005). The content of networks provides essential determinants for understanding the value created by relational activities (Hansen et al. 2001). However, despite several attempts, the partners in this entrepreneurial ecosystem could not repeat its success in other territories. Rodan and Galunic (2004) proposed that a relationally embedded approach can provide insight into social capital creation, and McEvily and Zaheer (1999) contend that the unique patterns of network linkages expose actors to personal pockets of knowledge that cannot be replicated. Irrespective of structure and content, it became clear in our case entrepreneurial ecosystem that the defining character behind value creation was participant behavior and the governance of that behavior. Ultimately networks only provide value creation opportunities through the transfer of knowledge and resources (Hughes et al. 2007). Knowledge transfer can be enabled theoretically by various forms of relational governance (Inkpen and Tsang 2005). For example, scientific members emphasized:

It has potential value to your area of research or ultimately within your area of business. It's kind of a virtuous cycle. The more you do the more of the stories and things that kind of happen, the awareness sort of spreads within the com-

pany. Stuff starts coming to me, rather than me pushing it and I start grabbing it. – Participant 9

We have productivity gains, not cost gains, i.e., we can reach a project completion in three years not six. This is clearly a benefit to industry. – Participant 2

The complexity of solving real world, multi-scale research problems... [requires] breadth of Knowledge and [a] number of brains on a project. – Participant 11

Firms, networks, and relationships evolve over time and in response to changing environments. Through interactions within changing states, we observed a dynamic process in which its observable state has a temporality defined by specific behaviors and relational governance. We present the stages of the evolution of networks and the entrepreneurial ecosystem itself in Fig. 1.

4.1.1 Pre-existing conditions for exchange

The findings revealed several contingencies before the entrepreneurial ecosystem formalized between the university and business partners and its stakeholders. These included prior academic-industry experience, institutional pressures, and constrained resources. Also, the mere development of a formal relationship between both partners did not give rise to an ecosystem. Initial relationships between the university and the multinational company gave rise to networks between the two. These networks grew to include new internal and external actors, locally, regionally, nationally, and internationally, growing both the physical size of the emerging entrepreneurial ecosystem and its reach. The relationship absorbed these new partners and evolved into an ecosystem as it developed internal and external legitimacy with stakeholders and behavior, and relations among partners grew. Simple network

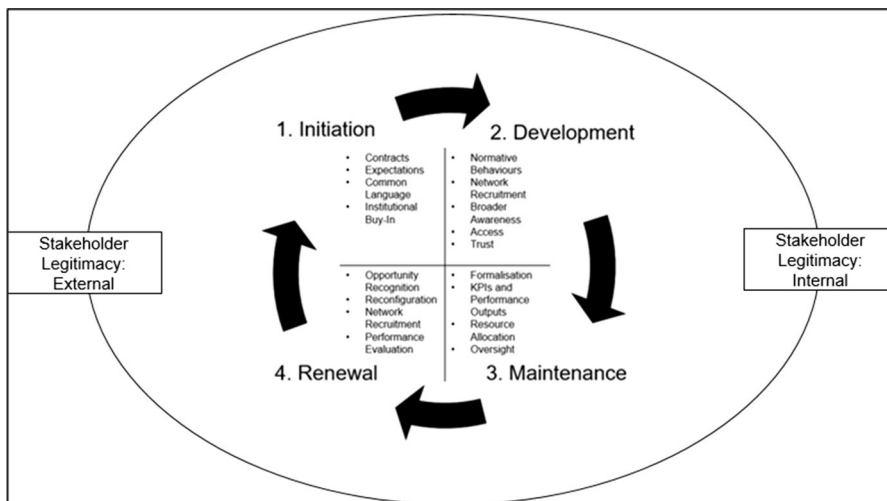


Fig. 1 Network evolution in entrepreneurial ecosystems

structure or content lenses would overlook that an ecosystem is only as vibrant as how actors collaborate or not within and across the ecosystem. This is fundamental to why the university–business partnership could not replicate its success in other territories.

The evolution of the networks and, ultimately, the entrepreneurial ecosystem further relied on governance. For example, initial relationships began with ad hoc contractual agreements replaced by a single master agreement with small additional agreements where necessary. This act reduced uncertainty for ecosystem partners, particularly over expectations, recourse, and intellectual property. However, contracts are inherently incomplete and restricting, calling for relational governance. The extent to which diverse partners can encounter challenges in alignment gives rise to the necessary use of intermediaries (Huizingh 2011; Wilson Report 2012). For example, while assessing economic objectives is an essential aspect of alignment, it is an incomplete analysis when conducted in isolation of each actor's goals and priorities (Larson 1992). In an entrepreneurial ecosystem of diverse partners and actors, divergence is expected and embraced, not assimilated. In our case ecosystem, university and business partners had very different objectives (e.g., economic versus scientific or utilitarian), and those goals differed yet again as more external and internal partners joined (or left) the ecosystem (especially at regional and national levels). Governance mechanisms adjusted to this reality to increase the vibrancy and number of relationships and not restrict them or else suffocate the oxygen fueling wealth creation in the entrepreneurial ecosystem itself. For example, an interviewee commented:

I think the IP terms are a more practical issue. But, I think that a bigger one is the more heart of it is the cultural difference. It's where the academics place the importance of industrial science. It's very different in the UK than it is here. It's hugely different. American universities a long time ago now, got a bug in their bonnet about monetizing their intellectual property and they do a horrible job of monetizing their developments. – Participant 7

These actions gave rise to new challenges as networks, and the ecosystem evolved. A significant factor that impacted this relationship were the variances in anticipated knowledge generation and research objectives to create a (sufficient) common ground. Senior leaders repeatedly spoke of “win–win relationships” as the gold standard, but what constituted that success differed across actors and partners. The alignment of organizational cultures and management practices (e.g., opportunity identification, definition, creation, coordination, and outcomes) (Kogut and Zander 1992), organizational climates for knowledge sharing and promoting acceptance and acclimation of innovation (Bock et al. 2005; Myer and Goes 1988), and knowledge combination capabilities and relational capabilities (Carmeli and Azeroual 2009) all emerged among our findings.

As illustrated in Fig. 1, relational and contextual features differ in each phase of development and emerged as a response to tipping points and critical challenges encountered at each phase. Each stage of ecosystem development is characterized by a point of evolution that shifts the relational development to a new development phase. For example, in the Initiation phase, the need for institutional buy-in across

the major partners required formal governance mechanisms such as contracts and clear expectations. In the Development phase, these gave way to relational mechanisms of trust and behaviors to enable recruitment and vibrant collaboration. The Maintenance phase required formalization of monitoring through key performance indicators (KPIs), more formal resource allocation to steer the direction of productive relationships, and oversight as a mechanism to generate internal legitimacy (that the ecosystem was delivering wealth creation). The renewal phase required reconfiguration and recruitment to revive the ecosystem and ensure new potential relationships could emerge among many new internal and external actors (including businesses, dealmakers, funders, government bodies, etc.). At this stage, generating external stakeholder legitimacy required evidence and success stories measured against performance evaluation relevant to those external stakeholders' goals. For example, an interview noted:

I certainly think that there are cultural leverages in the way that British government funds research and drives alliances. – Participant 8

The case evidence cautions against over-relying on deterrence-based (mechanical) trust mechanisms emphasized in the university-business literature. Deterrence-based trust emerges from the knowledge that a partner will not behave opportunistically because of the known costly sanctions that will follow. Deterrence-based trust is contractual and based on a distinct set of guidelines about penalties for malfeasant behavior (Gulati 1995). Contracts deter opportunistic behavior. However, in excess, rigid contracts, formal structures, and institutionalized rules can limit knowledge creation (Allen and Strathem 2003; Kadushin 2012). Knowledge-based, relational trust, instead, is based on social norms and is crucial when behaviors, events, and outcomes cannot (and should not) be fully predicted and accounted for within contracts or else limit the scope for *realizing* entrepreneurship *intended* in entrepreneurial ecosystems.

We now discuss each phase of ecosystem evolution.

4.2 Phases of ecosystem evolution

The analysis revealed four major tipping points that resulted in further development stages: Initiation, Relationship Building (or Development), Maintenance, and Renewal. The transition from each phase was characterized by critical points that demanded actions causing a shift in focus to maintain the vitality of the relational exchange for continued value and wealth creation within the ecosystem. The successful transition to further stages in network development depends on taking appropriate responses and actions at each tipping point. Each phase presented a new challenge that required complex social processes to be coordinated, which held implications for network structure and operational focus. First, we observed some degree of self-organizing processes at play in the ecosystem's construction and growth, especially across Phases 1 (Initiation) and 2 (Development). As networks of relationships among actors within the entrepreneurial ecosystem grew in self-organizing and organic ways, this network fragmentation benefited the ecosystem's

development. It allowed new pockets of relationships to emerge to attend to new and novel opportunities. A rigid approach network structure would have constrained this serendipity. However, that same fragmentation created consequences in Phases 3 (Maintenance) and 4 (Renewal). In Phase 3, fragmentation complicated the need to establish and evidence the entrepreneurial ecosystem's performance to internal and external stakeholders (e.g., as a way to recruit more resources, recruit more participants, expand its regional and national socio-economic and political influence and prominence, etc.). This created a need to formally track the value and wealth created through the time of the entrepreneurial ecosystem. In Phase 4, the introduction of rigid monitoring mechanisms, KPIs, and planning in Phase 3 had the initial effect of diluting actors' capacity to adapt to new opportunities, necessitating change. Sub-networks primarily drove renewal within the ecosystem, and the need to orchestrate new relationships as the number of actors and partners within the ecosystem grew. These insights further reiterate a difference between composition (structure and content) and behavior.

4.2.1 The initiation phase

The potential for conflicts about knowledge ownership and commercialization of developed technologies characterized the Initiation phase. Underpinning this conflict was a common dissatisfaction between the university and business partners in defining a sustainable business model for their overarching relationship and, fundamentally, what type of ecosystem they ultimately wanted to germinate. To be clear, both partners valued their roles as regional leaders, and local enterprise partnerships were important stakeholders to both organizations and to the nascent ecosystem they sought to establish. This process of conflict, negotiation, and agreement provided a common language necessary to initiate the ecosystem (Fig. 2).

A further complication stemmed from the tendency for relationships to have idiosyncratic contracts for each new project or relationship, the implication being that within any one relationship, many different legal contracts could be in place, each accounting for a specific project. The governance and project management

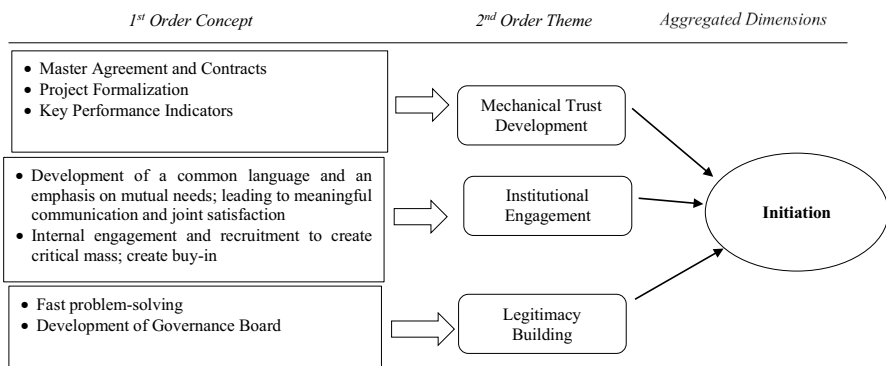


Fig. 2 Initiation phase thematic analysis

complexity this creates is inefficient and unattractive to grow an overall university-business relationship or intent to germinate a regional entrepreneurial ecosystem. To minimize the negotiation process, the governance of the overarching relationship, and accelerate project development and approval, the focal university and multinational company established a ‘master agreement’ to govern knowledge ownership, intellectual property, and technology commercialization on a scale that covers the partner organizations rather than any one individual. This governance approach is unusual and not standard practice but allowed the network to grow in size and scale very quickly, sub-networks to emerge organically, and new relationships to form in fast response to new opportunities. For example, in the first year of the relationship alone, 7 innovation projects were set up, and over the course of the next four years, a further 55 innovation projects were established. As an interviewee noted:

Another thing that the partner does really well is that they are really good at bringing together all of those disparate parties and finding common ground that everyone wanted to work together and had passion to do so. That doesn't always happen. – Participant 7

Apart from the transaction cost advantages, there are institutional advantages to this form of coordination mechanism. Specifically, the master agreement contract creates mechanical trust that simplifies new project development, allowing the focus to shift squarely to more strategic issues rather than diverting attention to a lengthy contract negotiation process and the micro-management of projects after that. It deters destructive opportunism while being flexible enough to enable new collaborations to form a ready governance framework. This is a further component of the ‘rules of the game’ established within the early stages of the relationship that enabled far greater scope for value creation for all parties. It also lent credibility and prestige to the relationship in its early years, encouraging more individuals (internally) to become involved in the relationship. This allowed for accelerated access to resources and project formation and allowed both partners to respond to new opportunities to drive growth and recruit new members (i.e., hitherto unconnected employees for both organizations) into the relationship. For example, interviewees observed:

One of the things that struck me is the desire to collaborate and to collaborate on very applied science. So, that was the very first thing. In North America, I would say that we are very big, very big country with lots of diverse ways of operating and very diverse opinions about what universities should be about. Whether they should be about applying the science for commercializing technology or whether they should be all about the fundamental understanding of the science. – Participant 7

One [task] was that they shared these technology needs and they were given under headings. One of the things that we were able to do was to spend some time mapping where our expertise lie within each one of those themes. And then to align the right people to talk to them about those things. That is an

example of what we did upfront to identify where the fit was. Find common ground, not just with the organization but with the individual. – Participant 11

I'm a businessman. What matters most to me is products on the shelf. It takes over 6 months for other universities to get a project going. This organization is faster. This is the model that we think we need, I am not going to come in here and drop a check on your table, I need you to work with me to find the value between your organization and mine. – Participant 2

Must be really buttoned up from the beginning. The thing about this is that you are really going to need to go buy-in. Monitoring is difficult. There needed to trust and confidence in order to get the projects running. - Participant 4

Formalizing the ecosystem occurred in Phase 2.

4.2.2 The development phase

The development phase constituted a significant effort at relationship building and focused on building internal awareness of knowledge-based resources and trust among the actors. This phase developed in response to the early momentum and success of initial interactions and projects. This stage focused on establishing the knowledge domains and effectively communicating the capacity for bringing in additional expertise. This stage reflected a level of vulnerability and learning, which encourages trustworthiness among the two main partner organizations. This developed knowledge-based trust, forming norms of commitment and learning through dialogue and setting expectations (Fig. 3).

Six months after the initial set up, additional members from the business came to the university campus to discuss their research objectives and goals. They provided a broad overview of their organization's current challenges in a presentation to members of the University departments. Following the presentation, individual academics could submit applications that proposed various approaches to addressing and solving those challenges. An interview participant recalled that *"Everyone had a fair chance to be involved, but only a*

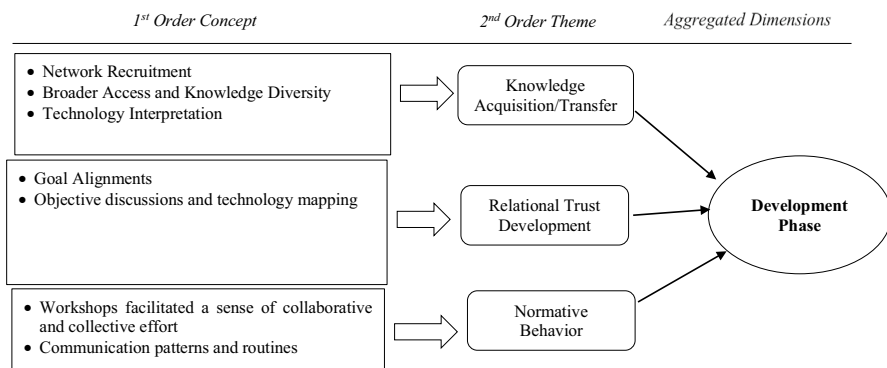


Fig. 3 Development phase coding procedure

few proposals were selected.”—Participant 9 This allowed the challenges to be refined and academics to be involved in the development of solutions. This was the beginning of the formation of a larger entrepreneurial ecosystem. The initial network of relationships was confined to a specific scientific area and now grew to incorporate more diverse experts and disciplines. This cascade is important as it grew the potential wealth creation opportunities for both parties and the possibility for serendipitous exchange. Concurrently, actors generated a greater sense of each other’s resources and knowledge and consolidated communication, shared language, and goals. This step also allowed participating actors to understand knowledge resources on a micro-level. A series of workshops were fundamental to this endeavor and serve as an initial, basic form of network orchestration that established each partners needed (and thus goals). An employee noted: *“The workshop takes the premise that a ‘stretchy’ technology can be thought of as a platform that has enabled the company to defend and grow its position in a market and/or enter or disrupt a market it hadn’t before.” – Participant 1.*

As networks and sub-networks grew in number, the entrepreneurial ecosystem itself formally took hold. Due to the new ecosystem’s burgeoning size and scale, members needed to become aware of the knowledge content and expertise available throughout. Initially, access was communicated through key gatekeepers that acted to increase connections across the network. This eventually translated to the members developing relationships amongst themselves, aiding in the development of the ecosystem. The frequency of interaction between the partners gave light to behaviors. This helped to ensure that the knowledge sharing behaviors, levels of commitment, and the interpretation of the results shared were aligned with each other’s expectations and goals.

One informant commented about an instance when the partner was working on a technique that had previously been proven ineffective by their research. This technique would not be sufficient for solving the challenge outlined in the project and this member of the relationship commented that: *“Although some time was lost, the partner reacted and shared prior results.”* This communication indicated vulnerability yet trustworthiness:

We had a technical issue recently where X truly thought what they wanted to go do was the right thing to go do, but I had a difference of opinion and I knew that my technical expert had a difference of opinion. So, then we had the discussion and things got fixed. And things moved forward but that can be, anytime that you are dealing with an external entity or someone, even though we have a good relationships with them, it’s not like we work with them every day in the same space. Participant 5

Developing knowledge- and competence-based trust, procedures and expectations were essential in the Development phase. These steps led to norms of commitment, dialogue, and improved expectations (including about frequency of exchanges or meetings) to emerge as mechanisms to reinforce and encourage further collaborations. The development of normative behaviors facilitated these shared expectations within the network, and the resources could be shared. These steps transformed the university-business relationship from a small

network of relationships into an ecosystem of far greater potential. The realization of that potential and the maintenance of its success became the focus of Phase 3.

4.2.3 The maintenance phase

The maintenance phase focused on the continual encouragement of collaborative behaviors and knowledge support. This growth in scale had increased the complexities in managing and maintaining the ecosystem from a relational perspective. This tipping point called for greater oversight, monitoring, and recording to capture risk and success factors appropriately. For example, although each of the project objectives and goals were crafted purposefully, the scale of the relational exchange now at play in the ecosystem, the drawing in of new external partners, and the potential for more purposeful collaboration across all members of the ecosystem needed a formalized method for continued alignment (Fig. 4).

This Maintenance phase focused on refining and more widely communicating the knowledge resources embedded within the ecosystem to create value and wealth. A necessary task was to enhance explicit knowledge stocks levels and use standard tools to improve communication. There was also a focus on developing documents and case studies that could be used as a platform for sharing knowledge among a more significant number of individuals, record and report success, and increasing the profile of this entrepreneurial ecosystem to external stakeholders. As the complexity of the relationship grew, the potential impact of each organization's activities grew. As many of the projects were built autonomously and organically, finding common ground for analyzing (and communicating) successes became essential.

The Board's coordination efforts set up to manage the initial relationship grew to manage the composition and governance of the ecosystem actively. While there was a desire to ensure that activity among members was stable, a supplementary objective was to support resource allocation by coordinating the growing number of internal and external participants brought into the ecosystem. As new members

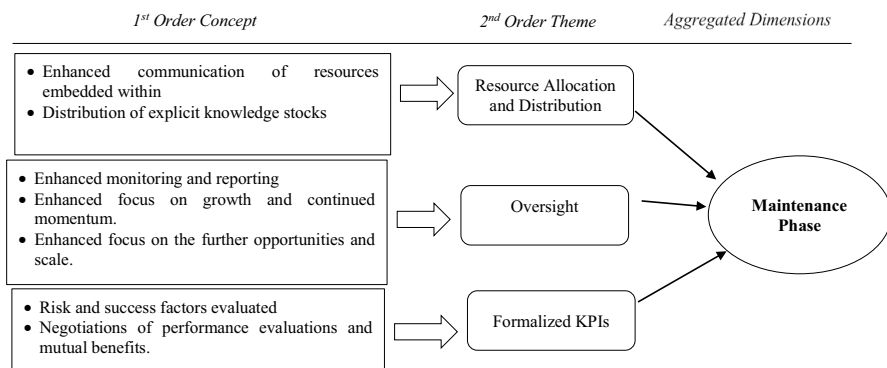


Fig. 4 Maintenance Phase Coding Procedure

became involved, the Board needed to identify and delegate members to acclimate and standardize practices. As a company representative noted:

Trust is needed to be confident in [making] investment, strong collaborations allow [for this]. If not, there would always be hesitation. An important mechanism is to build trust. But, with X it's an opportunity trade-off to get richer value. – Participant 1

For example, the management board recognized that a level of success from current projects was related to the technical transfer meetings hosted once a month. The scientific staff engaged in technical transfer meetings to discuss and problem-solve issues on active projects. For instance:

The fellow that we are working with is a relatively new addition to the organization. Very enthusiastic to do the partnership. He actually brought some of these ideas on how it might get additional resources on to the project. He brought those to us and works very well with us to do that. Participant 5

However, the power of initial relationships risked the exclusion of abundant opportunities brought by new members. For example, any network, or ecosystem by extension, faces risks of becoming path-dependent and losing momentum during this phase. There were concerns that management practices could be developed too tightly and preclude collaboration—the balance between calculated risks and fostering innovativeness through separating the administrative and entrepreneurial tasks and coordinated that through a single management board. The management board needed to ensure that the network was strategically and intentionally curated to continue building on its success. This meant accommodating a greater number of new internal and external partners while being cognizant of their goals. Concurrently, participation in the technical meetings, for example, was declining as junior members oscillated out of the relationship (e.g., on project completion). Moreover, there was evidence that people became too connected to the same individuals, reducing their exposure to different knowledge sources, and depleting the ecosystem's potential to sustain its vibrancy and vitality (in entrepreneurship and innovation terms).

4.2.4 The renewal phase

The entrepreneurial ecosystem had only just entered the Renewal phase. The striking aspect of our findings was how rapidly the ecosystem had evolved to this phase. The Renewal stage emphasizes opportunity identification through new ecosystem partners and new project proposals. In many ways, it is a corollary of the problem presented in the Maintenance phase that certain ecosystems (especially one driven by technology and science) run this risk of path dependencies in the networks that underpin the vibrancy, vitality, and wealth of the ecosystem itself. This phase was enacted in response to the evidence of stabilization within the network and the loss of momentum that occurred as entrepreneurial and innovation projects were completed. Prior ties became latent or dormant (a phenomenon highlighted by Hughes and Perrons 2011). The Board and members of the relationship focused

on rejuvenating the momentum experienced in the early phases of the ecosystem's development and ultimately renew and rejuvenate the ecosystem. This led to purposeful attempts introducing new projects to regain lost momentum, and purposeful recruitment of new internal and external members. At this stage, generating linkages with new external, non-competing partners became an essential act. For example, the partners looked to establish research consortiums with new organizations and universities:

[We sought] to develop new application ideas for 10 well-developed technologies in the current field of application or in other fields... [and] progress technology application opportunities. – Participant 9

A final yet critical theme that emerged in this investigation was the need to continually engage with external institutional forces and continually manage legitimacy through all network development phases. The group needed to define the necessary tools to communicate the 'how' and the 'why' effort should be expended on development to a broader audience, indicating that the network activity extends beyond the partner organizations and has an impact beyond the boundaries of the relational exchange (Fig. 5).

5 Discussion and conclusions

The literature on entrepreneurial ecosystems is still in relative infancy, but a persistent, albeit underappreciated theme is their effective functioning over time (Garnsey and Leong 2008; Beliaeva et al. 2019). Overlooking this aspect of entrepreneurial ecosystems has led to an excessive focus on the structure and content of entrepreneurial ecosystem at a cost to a relational view of entrepreneurial ecosystems and their governance (Aarikka-Stenroos and Ritala 2017; Kang et al. 2019; Scott et al. 2019; Spigel 2017). This oversight has had two effects. First, policy-makers continue to rely on importing practices seen among thriving ecosystems on the assumption that such practices are somehow 'best'. This has led, unwittingly,

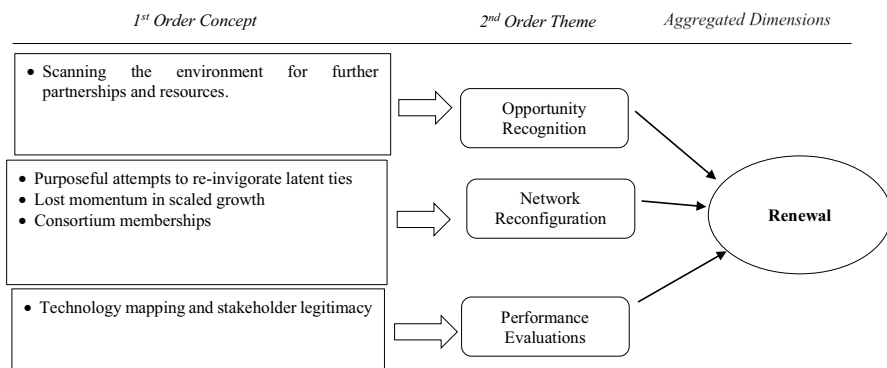


Fig. 5 Renewal phase coding procedure

to neglect interdependencies and behavior among actors as the vital mechanism by which the structure and content of an ecosystem are advantaged on or not (Harrison and Leitch 2010; Motoyama and Watkins 2014; Spigel 2017). Second, this has led to a static treatment of how entrepreneurial ecosystems emerge from networks of inter-organizational ties and the behaviors and the governance mechanisms needed at each phase of its evolution to maintain the vibrancy, vitality, and wealth creation of the ecosystem. In addressing this oversight, we shed new light on factors that are rooted in behavior and governance instead of local conditions (Cavalo et al. 2018; Scott et al. 2019) or the social context or ecosystem composition alone (e.g., Beliaeva et al. 2019; Mueller and Jungwirth 2016; Kang et al. 2019). We provide three contributions to research on entrepreneurial ecosystems.

First, we answer Spigel's (2017) call for a relational perspective on entrepreneurial ecosystems. Departing from traditional studies, we depict entrepreneurial ecosystems as consisting of multiple networks as a solution to limitations in structure- and content-based views of ecosystems. Ecosystems present resource and knowledge exchange opportunities and value creation, but not necessarily their access or value realization. A failure to treat ecosystems as networks leads to the danger of treating any region with high rates of entrepreneurship as an ecosystem (Spigel 2017), but without understanding why those regions can productively create wealth over other regions. This deficit was apparent in our case ecosystem, where the core partners originating the university-business relationship that ultimately germinated the ecosystem could not replicate its success elsewhere. Their inability to do so in contrast to structure and content ideas, both reasonable to duplicate, drawing attention to behavior as the complicating feature (immutable and less pliable to replication). Behavioral interaction provides an answer for how entrepreneurial actors might enact and maintain relationships within effective entrepreneurial ecosystems and ever-changing environments (Autio and Thomas 2013). An interaction element is essential and reveals the role of behavior as the essential mechanism in the vitality, vibrancy, and wealth creation of an entrepreneurial ecosystem.

Second, further departing from existing studies, we show that this behavior is not universal but changes across phases in the evolution of an entrepreneurial ecosystem. The importance of networks to entrepreneurial outcomes is well-documented (e.g., Hoang and Antoncic 2003; Nijkamp 2003; Stuart and Sorenson 2007). However, accessing and releasing the resources, knowledge, new relationships, finance, opportunities (among the many other purported benefits of networks and ecosystems) is contingent on network behavior and its coordination through relational governance (Hughes et al. 2007, 2014; Kogut and Zander 1992; Rodan and Galunic 2004; Scott et al. 2019). We reveal the phases of evolution, the challenges and tipping points at each stage, and shed light on the behaviors and relational governance mechanisms necessary to enrich the entrepreneurial ecosystem and precipitate movement to its next phase of growth. Insofar as entrepreneurial ecosystems represent a set of interdependent actors, a structure or content view of ecosystems sees wealth creation solely as a composition problem (the right 'ingredients', for instance). However, our findings emphasize that factors must be coordinated to enable productive entrepreneurship within a particular region or territory following Stam and Spigel (2018). Building on this, what is

apparent in our findings that networking behavior in the first two phases (Initiation and Development) was driven towards establishing a common language then innovating projects and growing connections across the emerging ecosystem to generate internal legitimacy among partners and actors. Contract-based governance gave way to trust-based relational governance. Networking behaviors in the next two phases (Maintenance and Renewal) led to consolidated networks that increased the degree of redundancy, requiring the management board to orchestrate new relationships and aggressively expand and refresh the number of actors, especially new external partners. This indicates a significant shift in the composition of the network necessitated due to actors' behavior creating unforeseen redundancies that depleted, not enhance, entrepreneurship and innovation. The renewal manifests as a response to that problem and, perhaps surprisingly, arrived far faster than we expected.

Third, implicit in the findings was the formation and use of social capital to unlock access to resources and knowledge and unlock collaborations for productive innovation projects among partners. We conclude that a distinguishing factor of an ecosystem versus a network is that this social capital encourages a focal network to grow, but new sub-networks emerge that further enrich the vibrancy and vitality of the ecosystem. Managing legitimacy within and amongst the various internal and external stakeholders is essential. Scholars contend that relationships' success or failure depends on the existing similarities between actors and organizations. Our findings suggest that these were necessary conditions as a catalyst for forming the underlying university-business relationship. To be clear, our case organizations had intended for an entrepreneurial ecosystem to emerge as a fruit of their initial collaboration. However, the joining of two fundamentally different organizations created a challenge around goals, expectations, and common language as a prelude to productive cooperative behavior among individual agents. Research supports that there is a level of strategy development with external partners. The impact of cultural variations between organizations can activate a tendency for uncertainty avoidance, emphasizing the importance of alignment and relational development behaviors (Barr and Glynn 2004). Our findings demonstrate that actions driven by common instead of competitive interests can serve to improve conditions across several stakeholders involved in the emerging ecosystem (Scott et al. 2019). However, the organization must then generate trust within the set of relationships it holds with another actor or set of actors for wealth creation to materialize. The focal organizations in our case ecosystem formed a master agreement to encourage cooperation to form, from which trust could then develop among individuals as knowledge- and competence-based relational governance mechanisms (e.g., Zaheer and Venkatraman 1995; Zaheer et al. 1998). While a common language and set of expectations were established in the Initiation phase, the entrepreneurial ecosystem's vibrancy and vitality could only be maintained by managing and orchestrating the network behavior of actors first, then supplementing the composition of the ecosystem's membership. Absence of behavior *and* structure *and* content considered in conjunction with each other rather than in isolation, we detected pockets of insularity, redundancy, bottlenecks within the system that precipitated an immediate need for ecosystem renewal.

This forms our final contribution and provides a new understanding of the rise and decline of an entrepreneurial ecosystem over time.

Collectively, our contributions provide fundamental building blocks for a theory and conceptualization of a network-based view of entrepreneurial ecosystem sensitive to how behavior and governance must change during the phases of ecosystem evolution.

5.1 Limitations and future research

The opportunity to conduct a longitudinal, in-depth study of a single entrepreneurial ecosystem and its foremost actors and partners offered significant opportunities to understand an entrepreneurial ecosystem's evolution and effectiveness. However, some limitations impinge on the work. First, our focus on a single entrepreneurial ecosystem prevents us from deriving additional insights and conclusions on its wider theoretical generalizability to ecosystems of different forms, composition, or purpose, or territory. Second, the data collection techniques and analyses within this study followed a robust research design, allowing for a multilevel triangulation opportunity. However, questions remain about whether the findings will repeat across other contexts and which of those findings are embedded within the 'local' ecosystem only. Third, our design foregoes the possibility of a cross-case analysis to explore similarities or differences in our findings. We attenuated this matter by acquiring insights into how the failed attempts of the focal university-business partnership at the heart of this entrepreneurial ecosystem replicate their success in other territories. Therefore, we have some confidence that our insights help justify the relational dimension as central to the unique wealth-creating power of an entrepreneurial ecosystem in line with the failure of policymakers to import successful so-called best practices seen among thriving ecosystems (Harrison and Leitch 2010; Motoyama and Watkins 2014; Spigel 2017). We contend that omitting behavior, governance, and the interdependencies among actors explain this failure. Further research is needed to contemplate this problem further. Fourth, our analysis of the case entrepreneurial ecosystem's evolution identified distinct phases and tipping points in which it was necessary to establish legitimacy with internal and external stakeholders. As this emerged organically from our data in post data collection analyses, we did not investigate this phenomenon more thoroughly. We recommend that future investigations directly adopt legitimacy theory to analyze the challenges of legitimizing the entrepreneurial ecosystem more broadly to internal and external stakeholders and the longitudinal functioning of this phenomenon.

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